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Science and Art Gossip.

EARLY on the morning of Oct. 27 some burglars entered the premises of Mr. John Browning, 63, Strand, by climbing a water-pipe 35 ft. high, taking a large square of plate glass out of a skylight, and lowering themselves 20 ft. by means of a rope. They then carried off binoculars, opera-glasses, gold spectacles and folders to the value of about £500. As nearly the whole of the articles bore Mr. Browning's name and address, and he has offered £50 reward, we hope he may recover his property.

ON Nov. 13-14 the earth crosses the orbit of the famous November meteor system known as the Leonides, but it is not likely that any shooting stars of the system will be seen, the gemmed part of the meteor ring being somewhere near the orbit of distant Uranus.

DR. HIND has calculated the elements of the comet observed by Dr. Schmidt, of Athens, on Oct. 9, 10, and 11, and finds an orbit presenting a remarkable general resemblance to that of the great comet. But the likeness is of such a nature as to suggest rather a past connection between the two bodies, than that they are now travelling in the same path.

MAJOR HERSCHEL states that on Monday morning, Oct. 30, he looked in vain for the great comet, though he watched for it for a full hour. "At last," he says, "when all the small stars of Hydra gradually settled themselves in my recollection in their right places, and I knew *exactly* where the whole length of the comet *must* be, I fancied at times that I could make out a faint illumination in the proper place; but not even then with the binocular could I find the head; nor could I, without previous knowledge, have been able to testify to the presence of the tail." This was only by reason of moonlight and a vaporous sky; for, on the morning of the 31st, the comet was well seen, and on Sunday morning, Nov. 5, the nucleus was conspicuous, and the long tail well seen without the aid of any glass.

DR. HIND announces the place given by M. Cruls for the comet he saw at Rio Janeiro on Sept. 12, differed by 5° 43′ in right ascension, and 1° 25′ in declination from that occupied by the great comet at the time. Observe our query mark in the diagram at p. 327.

THE letter of Darwin's which recently appeared in the *Academy*, and has now been quoted and requoted in many professedly religious papers, was, it appears, a retranslation from the German. The words of the original English letter are thus given by Professor Hæckel:—

To Nicholas Baron Mengden.
June 5, 1879.
Down, Beckenham, Kent.

Dear Sir,—I am much engaged, an old man, and out of health, and I cannot spare time to answer your question fully—provided it can be answered. Science has nothing to do with Christ; except in so far as the habit of scientific research makes a man cautious in admitting evidence. For myself, I do not believe that there ever has been any Revelation. As for a future life, every man must judge for himself between conflicting vague probabilities.

Wishing you happiness,
I remain, dear sir, yours faithfully,
CHARLES DARWIN.

One scarcely knows which most to wonder at, the impertinent curiosity which elicited the letter or the bad taste which led to its publication. If we were not assured that every reader of KNOWLEDGE has already seen the letter as first less correctly given, we should not now publish the correct form; for, a man's views on such matters are no concern of others, unless he himself chooses to publish them.

WE are assured that the Temperate House Gate of the Kew Botanic Gardens was to be restored, "with the full concurrence of Sir Joseph Hooker." Otherwise, we might almost infer from the look of the place, that the Lord of the Manor was suffering under a fit of baronial sulks. The bricking-up has been stopped, but as yet that is all.

YET he should be cheerful. We were doubtful about the morning sport within his demesnes. But we learn that the sport is good. With gardeners to beat the bushes, many rabbits are shot. Query, are the men thus employed entered in the books as gardeners or as gamekeepers?

THE Holborn Restaurant, which will be one of the finest in the kingdom when the alterations now in course have been completed, is to be lit throughout by the Edison Electric Light Company. About 1,000 lamps in all will be used, partly of eight and partly of sixteen candles.

To produce "crackle" surface glass, a French inventor, M. Bay, covers the surface of a sheet of glass with a paste made of some coarse-grained flux, or easily fused glass, and placed on a table in a muffle, and subjected to a high temperature. When the coating is fused the sheet is withdrawn and rapidly cooled, and the superficial coating separates itself and leaves the irregular surface. By protecting some parts of the glass from contact with the flux, designs and lettering may be left in smooth glass.

WE have received, says the *Southampton Times*, a copy of Messrs. Adams & Stilliard's photographic group of the members of the British Association who sat singly at their studio during the brief and busy visit of the British Association at Southampton. The general aspect of the fifty members comprising the group is one of dignified ease—characteristic of the men individually. They do not

appear to be having their portraits taken, but rather to be thinking out some problem at their usual work, quite regardless of criticism. Some of the heads give us the impression of power, repose, and precision, especially those of the President (Dr. Siemens), Mr. Hawkesley, Captain Abney, Mr. Proctor, Sir William Thomson, and Sir Henry Bessemer. There is the genial illustration of thought in Lord Mount-Temple, Dr. Crosskey, Mr. Tate, C.E., the Rev. Adair Pickard, and others. Nervous, eager thought and activity are depicted in Professor Cayley (President elect), and the Rev. Canon Wilberforce; and alertness, sufficiency, in Colonel Sir Charles Pearson and Captain Bedford Pim, R.N. But we are getting near home, and must be cautious. The reader has ample study left in the fifty heads. Others are not less exact and powerful in various directions, as his Excellency Don Arturo de Marcoartu, Mr. Hyde Clark, Professors Leone Levi, Acland, Tilden, Gamgee, Lawson Tait, Lodge, and Pearce. The key is a tracing from the larger group in outline, with the names, &c., inserted, to avoid all labelling or reference to numbers on the photo.

Swan Incandescent Lamps are being adopted very extensively on the large oceanic passenger steamers, the latest being the *Arizona*, of the Guion Line. There will be about 300 lamps in the ship, every part of the passengers' and officers' quarters being lighted by them, to the exclusion of oil and candles. Special attention is being paid to the illumination of the engine-room. Lamp sockets are fitted near various parts of the engines that require occasional attention, and the men are provided with loose lamps in very strong globes, and of such a size that they can be carried in a jacket pocket, and fitted into the sockets when required. Lamps with flexible heads are also supplied, and can be coupled to the same sockets.

The specific volume of the different constituents of green woods has been estimated by M. Hartig to be as follows, per 1,000 parts:—Hard green wood, fibre stuff, 441; water, 247; air, 312. Soft green wood, fibre stuff, 279; water, 317; air, 404. Evergreen wood, fibre stuff, 270; water, 335; air, 395. A certain amount of water—7 or 8 per cent. in all—is included with the fibre stuff, showing that about one-third only of the mass of the wood is solid stuff; the remainder is either water or air space. This is quoted in some articles on painting in the *Railroad Gazette*, to show how necessary it is that wood should be in a normal state of dryness before painting.

Mr. Chamberlain last Tuesday week, in replying to deputations from Birmingham and Sheffield, whose object was to point out the difficulty in which they were placed, while desirous to prevent any company obtaining a monopoly, said that if the local authorities could not undertake the work themselves, they must, in their own interests, endeavour to make some arrangements with an electric lighting company. It was impossible for the Board of Trade to postpone the issue of Provisional Orders. The Electric Lighting Act did not contemplate monopoly on the part of any one, and in the event of a public company obtaining a Provisional Order, and not satisfactorily carrying out the lighting arrangements of a locality, the Board of Trade would be prepared to consider any application from the local authority, or other body, for a second Provisional Order.

December 21 has been appointed by the Board of Trade for applications to be made for Provisional Orders under the Electric Lighting Act, but licences may be applied for and granted after that date.

The Idaho *Statesman* says:—"The activity of volcanic action in the Snake River lava beds, near the line of the Oregon Short Line Railroad, is driving many of the graders from the work. In an area of about twenty-two square miles, at short distances apart, smoke and flames of peculiar odour, colour, and shape issue from the chasms and seams in the lava. The irritating sulphurous vapours in themselves cause many to quit work, while the unusual agitation of the boiling springs and the general commotion all over the fields of lava has caused a superstitious fear to take hold of many of the railroad hands, and they are leaving the section terror-stricken. The whole area has the appearance from a distance of being on fire."

"To talk of the athlete who sat for Phidias's Theseus," says the *Quarterly Review*, "is radically to mistake the character of that master. The figures of the Ægina pediment were not copied from figures of athletes, but all from one ideal, representing in the mind of the sculptor the warrior in the abstract; while Phidias has a variety of ideals" [this is well said] "instead of one, varying them according to the character of the being he has to represent. But his procedure is not radically different; he works not by sight, but by measurement and his idea of a perfect form. . . . . We must remember that the Greeks wore extremely little clothes at any time, and that when they went to exercise in the gymnasia, they threw off even these, and remained quite naked. A sculptor, therefore, had only to pass a few hours in a gymnasium, to see hundreds of vigorous and active forms posed in all kinds of attitudes and engaged in every form of exercise. The nude male form would become as familiar to him as the clothed human form is to us; he would judge the beauty of individuals with rapid decision, and form from the comparison of many a sort of canon or standard of beauty."

The formation is announced of the "French Electrical Power Storage Company," with a capital of £1,075,000. This is for the manufacture and so on of the Faure accumulator, of which a great deal has been said in this country, but of which exceedingly little has been seen. Mr. Simon Phillipart, well known in connection with the Faure battery in this country, is the first-mentioned subscriber in this big capital French company, a capital which most people would say it is utterly impossible to employ in Faure battery making.

The Postmaster-General has just contracted with Messrs. D. J. Dunlop & Co., Port Glasgow, to build for the service of the Post-office an iron screw steamer, specially constructed for the laying and repairing of telegraph cables. This vessel has long been much wanted, and will be built from designs by Mr. Joseph H. Ritchie, Fenchurch-street, London. The principal particulars of the vessel are:—Length, 240 ft.; breadth, 33 ft.; depth, 20 ft.; to be propelled by a pair of engines, having cylinders 30 in. and 58 in. diameter, with a length of stroke of 48 in. To meet the requirements of the special work to be performed, the steamer will be fitted with three circular telegraph cable tanks and a double bottom for water ballast, with fittings adjusted to trim the ship as the cable is paid out.

☞ Erratum.—Page 375, col. 2, line 40, for "Sey" read "Ley."

THE MIDLAND ACCIDENT.

By R. A. Proctor.

THE terrible accident on the Midland Railway has led several of our daily and weekly papers to speak of the dangers of the American railway carriages. Those who have so written can simply know nothing of the American system. Every car in America is well warmed either by hot-air pipes or by a stove, and this arrangement has been in vogue for more than a quarter of a century; yet such an accident as happened on the Midland has never been heard of in America, and could not possibly happen there. For three sufficient reasons. First, each car by day and by night is properly watched, being practically under survey of all the train servants not actually employed on the engine, but specially watched, if a "Sleeper," by its own conductor and porter; secondly, no one would be allowed either to smoke in his berth or to carry a reading-lamp—an American conductor who should be offered a dollar to allow this to be done would behave very much as an English officer who was offered a half-crown to tell his general's plans to an enemy; thirdly, there is not throughout the length and breadth of America a train which presents the absurdity of combined gangway or aisle cars like the Pullman and thwart boxes like our English carriages; the gangway down the middle of a Pullman is, in America, simply a part of a chain of gangways running the entire length of the train.

What was American in the car was the saving of life. No one who has ever travelled in America will believe that the fire was caused by the warming apparatus. It undoubtedly had its origin in one of two personal acts, which ought both, as Sala well remarks in the *Illustrated London News*, to be made criminal offences, punishable by fine and imprisonment. If an ordinary carriage had been set on fire in that way, there would have been no chance of escape for anyone in the compartment where the fire originated. But, in the Pullman, despite the additional risk introduced by the absence of all power of communicating with the driver, every one was saved except the unfortunate man in whose berth, it is too probable, the fire began (who was possibly asphyxiated before the fire fairly broke out).

I say that there was no power of communicating with the driver, because the ingenious arrangement actually adopted is equivalent to cutting off all communication, in the most probable cases rendering communication desirable. In British and continental trains an arrangement is adopted which *might* possibly tempt an unfortunate passenger murderously assaulted by another to lose all chance of effectual defence while trying to communicate with the driver. One pictures the poor wretch leaning out of window to feel for the rope while his assailant did for him effectively, or on the continent trying to break the glass which covers the communicator, instead of trying to break the force of his assailant's attack. But under no circumstances can one conceive any benefit arising from the attempt to use the ridiculously futile excuse for a means of communication with the driver.

Every one who has travelled much both in Europe and in America, will agree with Mr. Sala's remark that "our present locked-in, boxed-up, stuffy, and narrow compartments, are absurd, dangerous, and scandalous to us as a nation." Because when railway travelling was first introduced, stage coaches were in fashion, the idea which a "slow" railway projector naturally formed was to make a train consist of a number of rather large stage coaches; and this arrangement, which was feeble-minded enough then, has remained in vogue for more than half a century.

Let me briefly enumerate a few of the advantages of the American system, and then I will touch on their more or less imaginary disadvantages:—

First, you can get on board an American train, or leave it, when the train is moving pretty fast, in perfect safety. I have run after a train and got in the rear car (with a helping hand from a brakesman) when it had attained a rate of certainly twelve miles an hour. I have never left one travelling at that rate, but by the rear car it could be done safely enough—at no worse expense than a sprawl.

Secondly, when on board you can choose any car or any part of any car to sit in; you can go to the smoking-car if you want to; or, if you like, you can visit the baggage-van to see that your luggage is safe—all when the train is at full speed. I have walked the whole length of a train with both hands occupied by satchels, &c., stopping only when opening and shutting the car doors.

Thirdly, if pressed for time, you can, in nearly all parts of America, go on board without a ticket, and obtain one at the first visit of the conductor.

Fourthly, tickets are attended to while the train is travelling. There is no absurd stoppage at the last station but one, and proclamation of "all tickets ready;" but, without delay of any sort, all tickets are collected *en route*.

Fifthly, the travellers by the train form a single community, with a force of conductors, brakesmen, porters, and luggage men, so that if a disorderly or drunken person gets on board, he must behave himself, at the risk of being turned off the train (in bad cases while the train is moving pretty fast, so that his exit is hasty and undignified, yet not unpleasing to those he had thought to annoy).

Sixthly, you generally travel in much more real privacy and comfort than in an English first-class carriage, not secured by a lawless fee to the guard. I used to find quite a rest in a railway journey between my lectures in America, with a little two-seat compartment to myself, all the passengers sitting in similar compartments facing one way; I could read or reflect undisturbed. Who can say quite as much of an English first-class carriage, if there are two or three passengers on the opposite seats? It is true that part of this arises from the "stony British stare," which foreigners and Americans find so strange and so unpleasant. But "fix it how you will," you can never feel quite so much at ease facing several persons, as when all face the same way. On one very special occasion, in America, when I had to travel in an ordinary car for several hours under circumstances which would have made staring excusable enough (not to make a mystery where there need be none, I was one of a wedding party of two), I was struck by the careful courtesy with which a two-seat compartment seemed to be regarded as if it were a private sitting-room. I never more thoroughly recognised the innate courtesy of all Americans towards ladies than I did on that occasion. Of course, when travelling in an American car, a man may be addressed by a fellow-passenger more freely than in England. But it is easy to answer pleasantly; and if the conversation wearies, either to close it or seek another place.

Seventhly, all the carriages are well warmed, and warmed quite safely. I speak without any prejudice in favour of car-stoves; for in a railway accident in Missouri I made a much more intimate acquaintance with one than I cared for, and shall carry the marks of the encounter to the grave. But one cannot expect stoves to behave well when the car they are intended to warm is pitched over an embankment thirty feet high. Under all the usual conditions of travel, they are perfectly safe travelling companions, and many a time and oft I have missed them

when shivering in an English first-class carriage despite wraps and the abomination known as a foot-warmer.

Eighthly, in all cars there is a retiring room: in nearly all there is a supply of drinking water; and in many there are conveniences for washing, brushing, and so forth.

If American trains only consumed their own smoke, they would be perfection; as it is, there is a very serious drawback to American railway travelling in hot weather. To reach your journey's end with collar, cuffs, and shirt-front, which had been clean a few hours earlier, reduced to smoke-stained, cinder-dust strewn clouts, is not a pleasant experience. The fault is one which might be easily corrected.

HOW TO GET STRONG.

(*Continued from page* 322).

THE DORSAL MUSCLES.

IN our last we mentioned the undue prominence given in this country to exercises which develope the dorsal muscles at the expense of the general development of the chest, and discussed the mistaken but very prevalent idea that rowing, as an exercise, is specially good for the chest.

Fig. 1. From a Photograph of a well-known Rowing Man.

We promised then to give some pictures showing, first the effect of much rowing exercise on the configuration of the chest, and secondly the proper shape of the chest when duly developed by the three classes of exercise which are good for it:—1st, exercises expanding it by acting on the breathing apparatus itself (the most healthful exercise of all); 2ndly, those which strengthen and develope the pectoral muscles; and 3rdly, those strengthening and developing the dorsal muscles. Exercises of the two latter orders do not in reality develope the chest at all, except indirectly by their action on the breathing; they simply enlarge the muscles which overlie the chest in front and at the back.

We were not able to fulfil our promise so soon as we had intended, because the Comet and the Transit of Venus, and some other matters which could not be put off, interfered. We do so now, however, at the first opportunity afforded.

Fig. 1 is from a photograph (the face altered, however,) of an eminent American oarsman. The weakness of the chest muscles and upper arms of this powerful sculler will be noticed at once; but this is a much less serious defect than hollow, overhung chest, and epecially the depressions

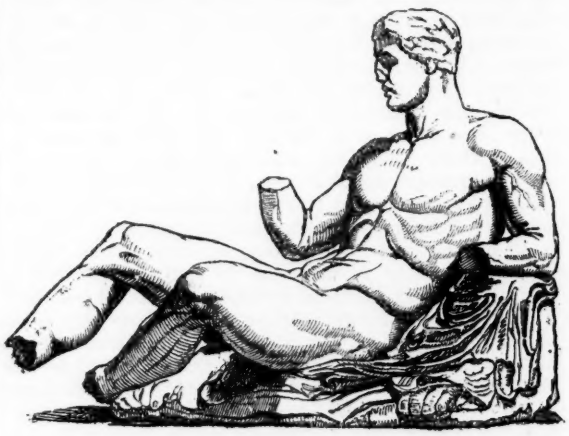

Fig. 2. The Theseus (supposed) of the Parthenon.

over the collar-bones. This configuration of the chest we should be disposed to regard as peculiar—not, indeed, to rowing men as a class, but—to those rowing men who do not correct the unequal effects of their favourite exercise

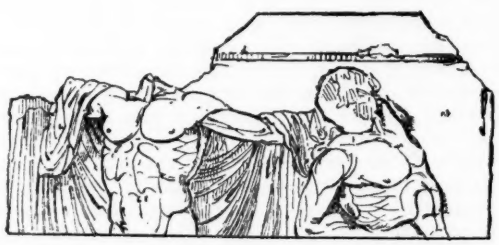

Fig. 3. From a Metope (Parthenon).

by the use of such chest-developing exercises as we have described in former numbers.

In comparison with Fig. 1 we give three well-known Greek figures, viz., Fig. 2, the Theseus of the Parthenon

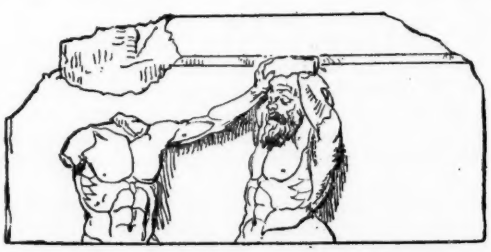

Fig. 4. From a Metope (Parthenon).

(as much of it as the unspeakable Turk left after his musketry practice at these noble sculptures), and Figs. 3 and 4, showing four chests in the upper halves of two Metopes from the same Temple. We would especially call

attention to the wonderful diversity of chest development in these four chests. The left-hand figures in each are Lapithæ, and the contrast between their well-developed but elegant frames and the coarser types of the Centaurs is worth careful examination, both as an artistic and as an anatomical study. But the two Lapithæ are also distinguished from each other, as are the two Centaurs. Of the two former, the one in Fig. 3 is the more powerful, but the other in Fig. 4 is more perfect. We know nothing in ancient or modern sculpture surpassing in beauty this perfectly-developed trunk.

THE TRICYCLE AS AN AID TO PHOTOGRAPHY.

By John Browning,

Treasurer of the London Tricycle Club.

IT is too little known what important assistance is to be obtained by using the tricycle when taking views by photography.

The use of the rapid dry gelatine plates has wonderfully simplified the apparatus required, and greatly reduced its weight, but an efficient set of apparatus, with say only three dark backs, containing six dry plates, with lens, camera, tripod-stand, and case, weighs from 10 lb. to 50 lb., according to the size of plates used. The lowest weight given will be about the weight of the apparatus required for taking views 4¼ by 3¼ in., known as quarter-plate size. The highest weight is that of apparatus for taking views 8½ in. by 6½ in., known as whole plate size. But the sizes most generally used when touring are 5 in. by 4 in., or 6½ in. by 4¾ in. The camera and apparatus for taking the first of these sizes would weigh about 15 lb., and that required for the second, known as half-plate size, weighs, in case complete, about 20 lb.

Now, few persons are satisfied to take pictures less than the last-named size, and 20 lb. is a considerable weight to carry for even four or five miles. But it is a weight that would be taken but little account of on a tricycle.

Mr. Herbert Salmon, the energetic captain of the London Tricycle Club, has recently had a set of dry-plate apparatus, weighing 20 lb., arranged on a Coventry Rotary Tricycle. He has so contrived that the apparatus shall hang as much below the tricycle as possible, so as to lower the centre of gravity of the whole machine, and he has placed it close to the single driving-wheel, which increases its grip on the ground. Attached in this ingenious manner to the machine, it adds to its steadiness, and prevents the slipping of the driving-wheel. The benefit thus received goes far to neutralise the small disadvantage of the extra weight, for on a tricycle travelling at a pace not exceeding seven miles an hour, 20 lb. is a weight that may be neglected.

The form of the Coventry Rotary Tricycle seems best suited to carry photographic apparatus, when arranged as I have described by Mr. Salmon, because the tripod for supporting the camera can be strapped on to the long bar which carries the two steering-wheels, but by the exercise of a little ingenuity, nearly any tricycle can be made to carry the apparatus almost equally well. For instance, with any front-wheel steerer the case containing the camera, lens, and dark slides may be strapped just behind the rider, underneath the seat, while the tripod stand, which in all properly-contrived portable apparatus is now made so that it either folds or slides into half the length, can be strapped on to the main axle.

As an instance of what varied work can be done with the camera, I may mention that Mr. Salmon sent me, within a week or two after he had adapted his apparatus to the tricycle, a view of Merstham Church, some views of Lingfield, a portrait of a favourite pug dog, a group of members of the London Tricycle Club before starting for Eastbourne, and an instantaneous view of the sands from a cliff in the Isle of Wight.

In the last view every ripple in the water is sharply defined, and one tiny speck about the size of a small pin's head, when examined with a magnifying lens, is seen clearly to be a lady dipping a child in the sea.

Mr. Salmon had not had any previous experience in photography.

It is evident that many other uses may be made of a photographic apparatus besides those so briefly indicated As well as views of any locality within twenty miles of the photographer, he could take interiors of churches, or other fine buildings, regattas, cricket matches, lawn-tennis parties, or portraits of friends or groups in their own houses or grounds. In all such cases the tricycle affords a ready means of conveying the photographic apparatus to the required spot.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Amelia B. Edwards.

XIII.—TEL ABOO-SOOLEYMAN.

NO local landmark, no corrupt survival of its historic name, indicates the site of Pithom, or Pa-Tûm. There are, however, at the western extremity of Wady Tûmilat two mounds which divide the honour of representing that city of sorrowful fame. The one is called Tel Aboo-Sooleyman; the other, Tel-el-Kebeer. Tel Aboo-Sooleyman—"the Hill of father Sooleyman," so-called after some native Sheykh—lies a little to the south of the western mouth of the valley, about ten miles from the mounds of Bubastis, as the crow flies. Tel-el-Kebeer—"the Big Mound"—now so famous as the scene of the victory of September 13, is situate some six miles along the valley as it trends from West to East. There is a small lake near Tel Aboo-Sooleyman, and there are several muddy ponds near Tel-el-Kebeer, all of which were anciently of larger extent, and which even now contain a considerable body of water when the canals are swelled by the annual inundation. Either the lake or the ponds might represent the "Pools of Pa-Tûm," near which the Shasu, it will be remembered, sought and obtained permission to pasture their herds, in the VIIIth year of Menephthah (See No. 50 of Knowledge, p. 325). Before being allowed to pass the "fortress"—that fortress which the Hebrews were levied to build by forced labour—the strangers' names were entered on a "list," or register, just as the names of travellers are now entered in the official books at Prussian and Italian frontier-towns.

Tel Aboo-Sooleyman, for the reason that it is so much nearer to ancient Bubastis than is Tel-el-Kebeer, would best answer to the description given by Herodotus, who, writing of the canal, says (as before noted) that it was "derived from the Nile *a little above* Bubastis, near the city of Patumus" (Pa-Tûm). Now "above" means further south, all such phrases as "upper" and "lower," "above" and "below," having regard in Egypt to the course of the Nile; and a glance at our sketch-map (see Knowledge No. 52, p. 357) will show how correctly, as regards latitude,

XUM

the expression "a little above Bubastis" applies to the mound of Tel Aboo-Sooleyman.

Nor must we forget the important evidence of that great topographical work which bears the name of the "Itinerary of Antoninus." In this Itinerary, all the home and foreign possessions of the Roman Empire towards the close of the First Century B.C. are described. Every main-road, cross-road, city, town, and military station is accurately set down; and the distances from each to each are given in Roman miles. Now, according to the Itinerary, we find the town of "Thoum" (Pa-Tûm) placed about half-way between "Vicus Judæorum" and "Sile," on the road from the Roman fortress called "Babylon" (old Cairo) to the city of Pelusium, on the Eastern coast of the Delta; the distance between Babylon and Thoum being given as 54 Roman miles.

It would really be difficult for the writer of a modern guide-book more exactly to describe the situation of Tel Aboo-Sooleyman. "Vicus Judæorum" is the Jewish city founded by Onias in the reign of Ptolemy Philometer, the mounds of which are now called "Tel-el-Yahoodeh" ("the mound of the Jew"); "Sile" is Salaheeyeh, now an important town, with a station which for the present terminates the railway-line about 22 miles beyond Aboo Kebeer. Taking these two points, Tel-el-Yahoodeh and Salaheeyeh, on any good modern map of the Delta (say Map 1, in Baedeker's "Lower Egypt," which is a model of clearness and accuracy) and measuring by a straight line from the one to the other, the mound of Tel Aboo-Sooleyman falls exactly half-way, as if put there for the purpose. Again, the distance from Babylon to Thoum is stated in the Itinerary at 54 Roman miles. The Roman mile measured 1614 yards in length; the English statute mile measures 1760 yards. Fifty-four Roman miles would therefore equal forty-nine and a half English statute miles, *plus* 36 yards. The precise line of the old Roman road is no longer known; but the present caravan-route from Cairo to Aboo Hammad, which takes an unusually direct course, is more likely to follow it than not. By this route, the distance between Cairo and Aboo Hammad, *viâ* Belbeis, is about 42½ miles, while from Aboo Hammad to Tel Aboo-Sooleyman is 6½ miles more—49 miles in all; which brings us within one half-mile of the distance laid down in the Itinerary of Antoninus.

I do not presume to affirm that these coincidences are conclusive, nor that so important a question can be decided by means of a pair of compasses and a map. Again, Tel Aboo-Sooleyman and Tel-el-Kebeer are but a short distance apart, and it might be urged that the foregoing evidence is as much—or very nearly as much—in favour of the one site as of the other. Yet, if it be demonstrated that the treasure-city of Pithom can only lie under one or other of these mounds, an important step is gained. The positive philosophy of pick and spade may be left to do the rest; and before the end of the first day's work, a couple of score of stalwart fellaheen, told off, half to Tel Aboo-Sooleyman, and half to Tel-el-Kebeer, would probably settle the question for ever.

Or shall we say, instead of a couple of score of stalwart fellaheen, the same number of stout British soldiers? A detachment will be permanently stationed for some time to come at Tel-el-Kebeer; and with abundant leisure on their hands, our men might find many worse ways of passing their idle hours than in looking for the treasure-cities of Pharaoh.

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"MUCH ADO ABOUT NOTHING."

IN these days of comic opera, of trashy sensational plays (devised to pander to a depraved taste), and of mawkish adaptations from the French, it is pleasant to find that overflowing audiences may still be attracted by good renderings of Shakespearean dramas. We find that though a play of Shakespeare's may mean bankruptcy to the manager, it may read triumphant success if the manager has just ideas of the great dramatist's work.

This is true, we take it, of all Mr. Irving's Shakesperean revivals, even those in which he has attempted more than he or his company could achieve. He may fall short of our conceptions of a Macbeth or a Hamlet, and still more completely of a Romeo; Miss Terry may not be Shakespeare's Juliet; other members of the Lyceum company may fail in rendering effectively the parts given them. But in every case the reading given, even when inadequate, has been the result of thought and labour. The aim has not been (as always where Shakespeare has failed to draw) to simply please the groundlings; we have had always the intelligent reading of a student and a lover of Shakespeare. Even Mr. Irving's shortcomings have had their part in his success. It may please his detractors to notice peculiarities of voice, or gait, or gesture, as if they were affectations. Those who have followed and watched his career regard these as they might regard some slight traces of the personal defects which seemed to debar Demosthenes from the career of an orator. That, despite certain seeming disqualifications, Irving should have become a powerful actor, makes him deservedly a far greater favourite than others who seemed born for the sock and buskin.

In Benedick, Mr. Irving has found a part which many who understand his genius have long since regarded as specially suited to his powers. It is a part in which actors whose fame rests chiefly on their efforts in tragedy, have achieved noteworthy success. It was this, perhaps, which led Charles Kean to attempt the *rôle*, in which, however, despite the able support of Mrs. Kean (his superior), he failed egregiously. But Kean was never successful outside a certain limited range of characters, chiefly tragic; Irving's power was first shown in comedy, and many hold that high comedy is still, and will always be, his strongest line. Benedick, quaint, witty, and humorous, now saturnine anon mercurial, but withal kindly and manful (witness his plain speech with the Prince in the first scene of Act II.), is a part admirably suited to Mr. Irving's humour.

The part of Beatrice is not quite so specially suited to Miss Terry's powers, but indeed her range is wider than Irving's, and Beatrice lies well within it. The secret of Miss Terry's success lies, we take it, in the power she has of putting herself in imagination in the position of the person she represents. Some actors and actresses—it is said the very greatest—possess a sort of intuition, teaching them how a person would look and act in given circumstances. We are told that Garrick, after a scene in which he had affected a whole audience to tears by his admirable personation of profound sorrow, would turn to a friend behind the scenes and laugh at the success he had achieved. It is not thus, we feel, with Ellen Terry. She seems to us never at her best till she has imagined herself into her part, so to speak, and simply looks and acts as her feelings dictate. It is thus, at any rate, she makes her earlier reading of a part; later, of course, she may find it easy to give equal force to her rendering without undergoing afresh at each representation the feelings which first suggested it.

It does not follow we need hardly say, that because

Irving and Terry faithfully study a character, and earnestly give their reading of it, this reading is necessarily right. Actors will tell you that they should be, and are, the best judges of a dramatist's meaning; but repeatedly it has been seen that this is not the case. Great actors and actresses have often, ere now, taken commonplace views of noble characters, yet have commanded attention by their histrionic mastery of their self-imagined characters.

Whether Irving has formed the truest idea of Benedick's nature, or Ellen Terry of Beatrice's, may be open to question. Shakespeare's characters (like the men and women of real life) are many-sided; and much more time than any actor has yet given to their interpretation might well fail to reveal all that is in them. For our own part, we must admit that after some thirty years' acquaintance with Signor Benedick and fair Beatrice—an acquaintance renewed many times each year—we are as far from fathoming their real nature as we are from fully understanding the character of our acquaintances in actual life. Mr. Irving and Miss Terry may have been more successful. Yet frankly, we miss certain qualities in their presentation of Benedick and Beatrice which the real Benedick and Beatrice, as we seem to know them, possess.

Benedick is a brave and steadfast gentleman, apt to say more than he thinks against women, and especially against one woman (of whom he thinks more than he knows), but tender-hearted and gentle,* slow to think evil yet thinking less well of Claudio and the prince than he speaks (though better than they merit, for they are shallow and ungracious, cruel, vindictive, and morally cowards, both), keen to recognise villany, true in friendship, faithful and withal generous in love. Mr. Irving's Benedick is nearly all this, but not quite. We cannot quite forgive his raising a laugh among the groundlings, just after Hero's most cruel trial. There is not a word said by Shakespeare's Benedick on that occasion which is not meant solely to soothe and comfort the sorrowing and indignant soul of Beatrice.

And how of Beatrice herself? How of the lady whose heart has been wrung by the villanous wrong done to Hero? If Miss Terry had not so touchingly and powerfully depicted Beatrice in that most affecting scene, we might have forgiven her for so thoroughly misunderstanding Beatrice's admission of love a few moments after. For all would then have been of a piece—Beatrice misunderstood throughout the finest scene in the play and one of the finest scenes in all Shakespeare. But that she should so move our feelings by her just rendering of Beatrice's sorrow, and should then render a confession of love which was, in truth, an appeal for sympathy, this was passing strange. Can aught be clearer? "It were as possible for me to say I loved nothing so well as you; but believe me not; and yet I lie not; I confess nothing, nor I deny nothing: *I am sorry for my cousin.*" As Miss Terry says these words, she and Mr. Irving moved hither and thither almost as farcically as the Milkmaid and her Archibald in "Patience," and the pit and gallery laughed loudly. Yet there is scarce anything more pathetic in all Shakespeare. The brilliant Beatrice, who till now has been moved by love to scornful jests, is now so moved by sorrow that she no longer cares to hide her real feelings. "I confess nothing, nor I deny nothing; I am sorry for my cousin." If Shakespeare meant to raise a laugh here, then, say we, as Dogberry enjoins, he's not the man we took him for. That something of her old scoffing manner should remain, we can understand. That in one of her spirit sorrow should be close on bitter anger, we can forgive, and almost approve. She is just, even in her fiery indignation. She rightly judges the Prince and Claudio. "What! bear her in hand until they come to take hands; and then, with public accusation, uncovered slander, unmitigated rancour—Oh, God, that I were a man!" But "I cannot be a man with wishing, therefore will I die a woman with grieving." Yet this scene raised laughter more than once; and the fault was not wholly with those who laughed.

(To be continued.)

* Mr. Sala finds in Benedick's "I'll devise thee brave punishments for him" [Don John], evidence of cruelty. We always understood him to mean that he would show the rest how to punish Don John best by letting him see how happy they all were in spite of his villanies.

SATURN'S RINGS.

I GATHER from the editorial note appended to the very interesting letter by Mr. Ward, on page 376 of the last number of KNOWLEDGE, that Mr. Maunder is exercised in his mind with reference to an absolutely imaginary claim on my part to have restored to Cassini the credit of having first discovered the division between the two bright rings of Saturn. I rather fail, though, to see how he can insist upon the merit of such restoration (*quantum valeat*) being due to Mr. Lynn, if it be merely based upon that fact that "two years ago" that gentleman "pointed out that the sketch said to have accompanied Ball's paper in the 'Phil. Trans.' was omitted from several copies." Apropos of what, I would ask, was this fact pointed out? Was it in connection with the actual question of the discovery of two concentric rings round the planet—or what? In this method of treating the matter I am rather afraid that the man who is at least as much entitled as Mr. Lynn to the credit of having brought the question to a definite issue (I mean, of course, Mr. C. Leeson Prince), is in danger of being lost sight of altogether. It was he who first induced me to examine the evidence in favour of Ball's supposed discovery; and I know personally, as a matter of fact, that he has for years been greatly interested in the question of Saturn and its system generally. He possesses a valuable library of old astronomical works, with the contents of which he is thoroughly familiar; and it is very odd indeed to me (to put it as mildly as possible) if he received his first hint that Cassini was the real discoverer of the duplicity of the ring from Mr. Lynn, less than two months ago. Mr. Lynn and he talked the matter over, as did Mr. Prince and I a few hours afterwards, and, on careful reflection, we all arrived at the same conclusion—viz., that the Brothers Ball never saw a trace of the division which has so long been called by their name. Mr. Prince's modesty is equal to his acquirements; and he is about the last man in the world to make any reclamation on his own behalf. I therefore feel it all the more incumbent on me to point out that it is through his initiation of the discussion that a satisfactory conclusion has at length been arrived at. As far as I was concerned, I found it stated in my copy of Breen's "Planetary Worlds," that Huyghens was written to in 1665 by Wallis with reference to the (alleged) perception of a division in the ring by Ball; and, thinking that the recovery of the original letter could not fail to clear up definitely the question as to what Ball really had seen (or fancied he had seen), I wrote to KNOWLEDGE (p. 295) to ask if any one could inform me whether this letter was still extant, and if so, where it could be found. This is

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the history of my connection with the matter. I know nothing about the astronomical magazine in which Mr. Lynn seems to have announced his (or Mr. Prince's) conclusions to a select circle of readers; but Mr. Maunder can scarcely expect such magazine to enjoy an absolute monopoly of discussion of a question which has previously been privately debated as this question has been.

WILLIAM NOBLE.

Forest Lodge, Maresfield, Uckfield.

THE GRISCOM ELECTRO-MOTOR.

THIS little piece of apparatus illustrates a principle of the utmost importance to those whose business or pleasure it is to deal with matters electrical. It may be remembered that some few months since we explained the principles of dynamo-electric generators. It was shown that the armature or coil of wire revolving before the poles of the large electro- or field-magnets, had a series of electric impulses induced in it. With a large machine, having an armature revolving at a high rate, the current induced as the result of the force expended in the steam-engine would be proportionately large, and capable of being applied to lighting, electrotyping, or any other of the many applications of electricity. But now we have to refer to a still further development of the principles of electric induction. If we pass the current produced in a dynamo machine, or its equivalent galvanic battery, into another similar machine, its armature will be found to revolve at a rate and with a force proportioned to the current traversing the coils. The explanation is simple —when the current enters the machine, a magnetic field is created, and, as a consequence, the movable armature revolves before the poles of the field-magnet. This, then, is what is known as the "reversibility of the dynamo machine." The motor we are describing is only a small one, with a resistance of about one Ohm, and is worked by a battery giving an electro-motive power of about 12 volts. Fig. 1 is a perspective view, and Fig. 2 a vertical sectional view. A small Siemens' armature (Fig. 2, A A), can be seen inside the field magnet (B B), which consists of a fixed ring of malleable cast iron, about $2\frac{1}{4}$ inches long and 2 inches in diameter. Two coils of comparatively thick wire are wound on the opposite sides of the ring to within about an inch of each other, top and bottom. C represents the commutator, which, of course, runs on the same axis as the armature. It consists of a drum of insulating material on to which a split-ring (PP) is attached. Instead of the ordinary slit-springs to complete the circuit through the commutator, little rollers (RR) are used. One pole of the battery (D) is shown as being connected to the commutator, the other to the field-magnet. The binding-screws used for this purpose are shown in Fig. 1 on the left-hand side, while at the opposite side is to be seen the little driving-wheel from which a band passes over the wheel of the sewing-machine, lathe, &c. The little bolt and nut

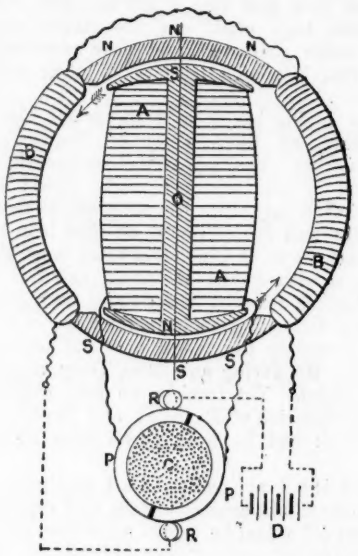

Fig. 2.

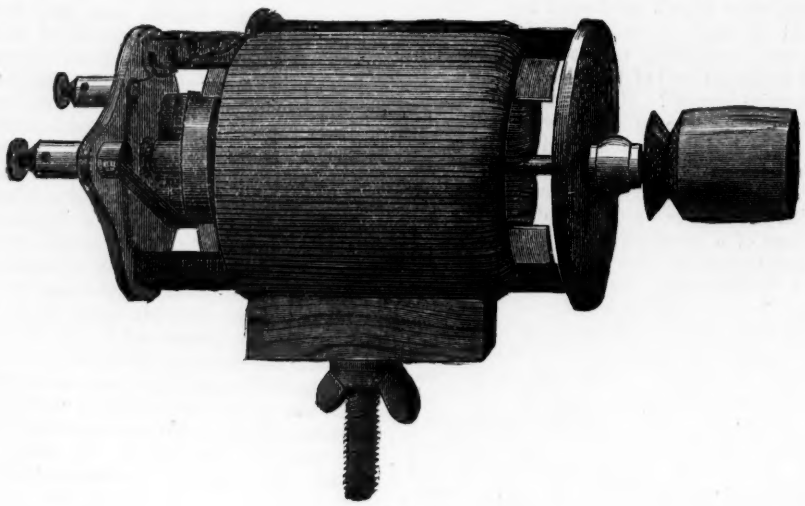

Fig. 1.

illustrate the method adopted for attaching the motor to the table or base of the machine to be worked. Fig. 3 illustrates the battery of six large single-fluid bichromate cells. Normally the zinc and carbon plates are kept out of the solution by means of a spring. When it is required to work, the machinist gently presses the treadle (drawn on the right of the figure), causing the plates to be immersed. By this arrangement there is a minimum consumption of the constituents of the cells, while the movements of the plates help to keep the solution in a state of agitation, and so prevent rapid polarisation. With the aid of Fig. 2 the reader may trace the course of the current from the positive pole of the battery through B B to the commutator, thence through the armature back to the commutator, and so on to the negative pole of the battery. The total weight of the motor is $2\frac{1}{2}$ lb., and the full speed of the armature 5,000 revolutions per minute, but it will be obvious on reflection that

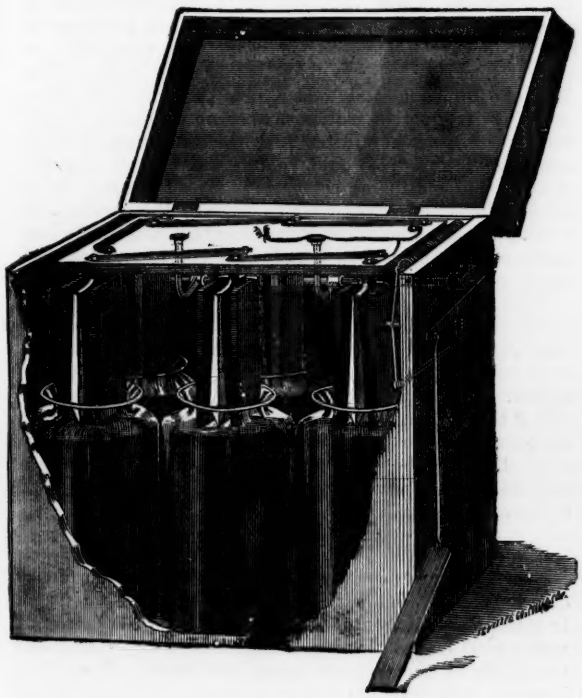

Fig. 3.

this speed may easily be moderated by varying the depth to which the plates are immersed. It is also worthy of notice that it is impossible for the sewing or other machines to be impelled in the wrong direction. With a greater current more work can naturally be accomplished, and we may mention that motive power equal to 1-h.p. is said to have been obtained. The current may be derived from a dynamo, when a number of the motors may be placed in the circuit. It promises, therefore, to be very useful in many small industries, more especially where the work to be done is small, and distributed over the various parts of a house or workshop, and under such circumstances, in fact, as would render the use of steam inadmissible.

This useful little motor, the invention of Mr. W. Griscom, of Philadelphia, is consequently almost universally admired for its size and simplicity, its cheapness and its efficiency, and we hope the efforts of the company in whose hands it is entrusted will be becomingly appreciated.

THE SUN'S FUEL.

WHILE thanking Mr. Proctor for his friendly notice of my "Science in Short Chapters" (KNOWLEDGE, p. 377), I must ask leave to correct his total misapprehension of my theory when he describes me as supposing that the sun, after having obtained his gravitation equivalent of the universal atmospheric matter, generates more heat by merely compressing on one side and rarefying on the other the same unaltered kind of matter. This would be quite on a level with the customary paradox of the perpetual motioners, and closely resembling what one would get by a pair of reciprocating pistons compressing the air of one cylinder by the elastic expansion of the other.

Mr. Proctor correctly represents my view of the effects of the original aggregation and condensation of atmospheric matter about the sun; but as regards my attempt to solve the great problem of the maintenance of solar energy, he has not even crossed the threshold of the argument, and has evidently "taken as read" my exposition of its essential points; for I cannot believe either that I am incapable of explaining, or he of understanding, what I intended to expound.

The threshold of the argument to which I allude, and at which Mr. Proctor halts, is that the heat evolved by this original aggregation and compression would dissociate the atmospheric compounds (notably water vapour), and thereby store a reservoir of heat; but beyond this, I have shown that the recombination and explosion of the whole of this is restrained by the limitation of radiation due to the "jacket" or envelope of the chromatosphere and outer atmosphere of the sun; this limitation determining the depth of the photosphere, or amount of surface combustion or recombination. Mr. Proctor has not penetrated even this, the vestibule of the argument.

A step further brings us to that "swaying of the sun around the centre of gravity of the solar system which Mr. Williams regards as an all-important point of his theory," and of which point Mr. Proctor altogether fails to grasp the significance. I maintain that this produces the irregular angular or rotatory velocities of the different portions of the solar photosphere which Carrington demonstrated (the equatorial portions making a complete revolution in 30·86 days, while those in latitude of about 50° revolve in 28·36 days), and that such irregularity, presumably shared by the outer vapour jacket, must produce vortices or cyclones on and about both borders of the equatorial solar zone; that these vortices must rip open that jacket thereabouts, and thus remove the restraint to combustion in such spots. The consequence of this (as demonstrated by the laboratory researches of Deville, Bunsen, and others) must be explosive outbursts in the trail of these vortices of a magnitude corresponding to themselves. This ripping open of the solar integuments, and consequent ejection of his dissociated entrails, is what we observe in the spots and prominences.

But what must follow the formation of this partial and local vacuum produced by such ejection? Evidently an inrush to restore the broken equilibrium of general gaseous pressure. I need scarcely work out the progressive steps of this restoration, first from the contiguous gaseous matter, then from the further distant, and finally from a *portion* of that cylinder of interstellar atmospheric matter which by the solar translation in space is (as I maintain),

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continually projecting itself upon the sun; while an exact equivalent of the projected and exploding prominence matter will be left behind in the wake of the advancing luminary, if not projected too far for this.

Now we come to the source of renewed energy. It is simply a portion of the heat that has been radiated through past ages from all the suns of the universe, and which I maintain is not extinguished, but is diffused throughout the interstellar matter. This is concentrated by the solar inspiration, and balances that which has been lost by his previous radiations; for the ejected gaseous matter of the prominences will, when fully expanded to the rarity of interstellar atmospheric matter, be colder than it originally was, by exactly as much as it had radiated during its compression, and by the flaming of its recombination. Thus, to quote my own summary at the end of Chap. VI. of "The Fuel of the Sun," "the heat radiated into space is received by the general atmospheric medium; is gathered again by the breathing of wandering suns, who inspire as they advance the breath of universal heat, and light, and life; then by impact, compression, and radiation they concentrate and redistribute its vitalising power; and after its work is done, expose it in the broad wake of their retreat, leaving a track of cool exhausted ether—the ash-pits of the solar furnaces—to reabsorb the general radiations, and thus maintain the eternal round of life."

The primary agent which I describe as effecting this is the explosive projecting force of the prominences. Mr. Proctor entirely omits this as regards its function in the maintenance of solar energy.

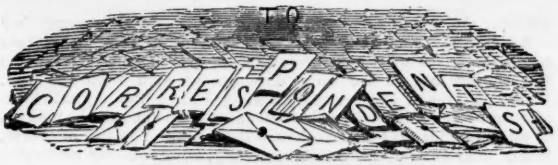
Knowing too well what an intolerable bore a man may become when ventilating his own theories, I refrain, at present, from discussing the other points raised by Mr. Proctor, but will do so hereafter, if his other self, the Editor of KNOWLEDGE, regards such discussion as likely to interest his readers. W. MATTIEU WILLIAMS.

[I consider that, apart from the interest which every discussion depending on important facts must needs have, common justice requires that Mr. Williams should be accorded space to explain and defend his theory. Referring to his present remarks, I note that he is mistaken in supposing I have "taken as read" any part of his theory. He may not mean it, but this is a truly painful accusation. I must try to show him how unjust it is. I might content myself by assuring him that I very carefully studied his "Fuel of the Sun," throughout, when it first appeared, and recently as carefully read the synopsis of the theory in his "Science in Short Chapters;" but this may, perhaps, not be sufficient. I would, therefore, invite his attention to the following passage in the former work repeated in the latter, "My hypothesis supplies a perpetual bombardment of 165 millions of millions of tons of matter per second, without in any degree altering the density, the bulk, or any other element of the solar constitution." If this does not correspond to the perpetual motion fallacy, when we remember that the efficiency of this bombardment must depend wholly on the velocity with which the sun travels through space, then either words are meaningless, or for many years past I have been in error about the very axioms of mechanics. *Here* is a *perpetual* bombardment, due to the sun's rush through the interstellar atmosphere—so that his motion is perpetual though doing all this work. If I seem to halt at the threshold it is because this awful stumbling-block lies there.

So again, with the effect Mr. Williams ascribes to the movement of the sun about the centre of gravity of the solar system. He thinks I fail to grasp the significance of this point. He says he "maintains that this produces the irregular angular or rotatory velocities of the different portions of the solar photosphere." But, as I read his book, he mistakes here: he does not *maintain* this—he simply *asserts* it. There is not even an attempt at proof. In his reasoning about it there are palpable flaws. For instance, he regards the disturbing effect of Jupiter as about 13 times that of the earth, that of Venus $2\frac{1}{2}$ times, that of Saturn a little above equal — the truth being that the tide-raising action (and the disturbance in the solar atmosphere must be akin to this) of Jupiter would be less than two-and-a-half times the earth's, that of Venus a little more than twice, and that of Saturn about a ninth of the earth's. I do not know, by-the-way, how Mr. Williams was led to suppose that Carrington's researches assigned to the solar equatorial regions a slower rotation than to the regions in solar latitude 50°. He now repeats this mistake, which he originally made in the "Fuel of the Sun." A slower motion of the equatorial photosphere may perhaps agree as well with his theory as a more rapid motion. (Some theories are so fortunate!) Still it checks a mere stranger, at the threshold, or even in the vestibule, to find that an error taking off a fifth of the equatorial velocity of the sun, and thus *reversing* its relative motion, makes no difference in the theory, and is not now, after near thirteen years, thought worth correcting. I would venture, however, to slightly change the metaphor, comparing myself rather to a surveyor who desires concisely to describe the qualities of a building, and who might well be content, though he had surveyed the whole of it, to note only the unsoundness of the foundation.

I should be very sorry for Mr. Williams to suppose I ventured to criticise his book without having examined it carefully. I hope the above remarks will show that I have noted other points than those touched on in my review. I can give further evidence in the same direction if that will afford him any satisfaction; but I must ask permission to select my points. One cannot criticise every line of a book. One can only take samples here and there, unless the review is to surpass in bulk the work reviewed.—R. A. P.]

THE MISSISSIPPI.—Some interesting and extraordinary *data* have just been compiled respecting the Mississippi. It appears that it boasts no fewer than 55 tributary streams, with a total length of navigation of 16,571 miles, or about two-thirds of the distance round the world. Even this, however, represents but a small amount of the navigation which will follow when the Federal Government has made the contemplated improvements in the Upper Mississippi, in the Minnesota, Wisconsin, and other rivers, in which it is now engaged. But while the Mississippi has 16,571 miles navigable to steamboats, it has 20,221 miles navigable to barges. This navigation is divided between 22 states and territories, in the following proportions:—Louisiana, 2,500 miles; Arkansas, 2,100; Mississippi, 1,380; Montana, 1,310; Dakota, 1,280; Illinois, 1,270; Tennessee, 1,260; Kentucky, 1,260; Indiana, 840; Iowa, 830; Indian Territory, 720; Minnesota, 660; Wisconsin, 560; Ohio, 550; Texas, 440; Nebraska, 400; West Virginia, 390; Pennsylvania, 380; Kansas, 240; Alabama, 200; and New York, 70. Nearly all sections of these states and territories can be reached with ease. Louisiana, Arkansas, Mississippi, Montana, Dakota, and the Indian Territory possess more miles of navigable stream than miles of railroad, all of which are open to everybody who wishes to engage in commerce.



Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

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"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

THE FINLAY COMET.

[618]—Justice to a painstaking and alert astronomer—Mr. Henry C. Maine, A.M., of Rochester, N.Y., U.S.A.—leads me to ask you to give insertion, if you so please, in your valuable paper, to the following concerning his discovery, on Sept. 30, of the disruption of the Cruls comet [the Finlay comet] into three parts:—

Sept. 24. Seven days after predicted perihelion the nucleus was intact.

Sept. 25. Nucleus seen as bright disc; dark channel behind the nucleus.

Sept. 30. Disruption of nucleus into three parts discovered.

Oct. 1. Discovery announced in Rochester, N.Y., *Democrat* and *Chronicle*.

Oct. 5. E. E. Barnard, Nashville, Tenn., verified the separation of nucleus into three parts, and made micrometric measurements.

Oct. 5. Cincinnati observers made similar observations.

Oct. 7. Washington naval observers saw three distinct condensations of light in nucleus, but no separation.

Oct. 8. Professor Schmidt, Athens, announced discovery of small comet, 4° S.W. of Cruls', and moving in same direction. Professor Lewis Swift, Ph.D., F.R.A.S., Director of Warner Observatory, Rochester, said this was probably part of the great comet; and, if so, would confirm the disruption.

Oct. 8. Mr. Maine predicted that on Oct. 9 an elongation and separation would occur.

Oct. 9. The prediction of the 8th verified by Mr. Maine.

Will you be kind enough to give me your opinion of the disruptive theory? [*What* disruptive theory?—ED.] If you have already done so, please refer me to the issue wherein it can be found, and oblige, SPEC.

CREMATION.

[619]—The *Standard* of Oct. 12 gave an account of what the writer calls "the first two cremations which have taken place in our country in modern times—viz., the cremation of the body of Mrs. Hanham, wife of Captain Hanham, and that of the remains of Lady Hanham, wife of the late Sir James Hanham, Bart., of Dean's-court, Dorset, both of which took place in Dorsetshire on the 8th inst." After describing the manner in which the process was carried out, the writer states that "the ashes of each body were collected with great care, and placed in a large china bowl, in which [he says] they will remain until urns of an approved form are ready, when they will be moved to a mausoleum." Now, will you allow me, through the medium of your valuable magazine, to suggest to the advocates of cremation a far neater and more appropriate mode of disposing of the ashes of a corpse cremated? These ashes, I think, consist wholly, or principally, of phosphate of lime, and therefore have only to be treated with sulphuric acid to convert them into sulphate of lime—*i.e.*, gypsum, or plaster of Paris. With this substance a model can be cast in a mould previously prepared, and representing either the full figure of the deceased, or simply the bust, or the likeness can take the form of a medallion. Whichever form of memorial is adopted, a glass case would be sufficient protection for it, and the costly urn can be dispensed with as unnecessary, whilst the remains of our loved ones will themselves be gathered into the form of a compact and lifelike memorial, which itself will be composed of the veritable "ashes of the dead."—In expectancy, A BROTHER CINDER.

CORSET WEARING.

[620]—Various reasons have been brought forward in favour of the wearing of stays by two recent correspondents, which, if true, are much in favour of using that support.

Corset wearing undoubtedly developes the upper part of the lungs, but at the expense of the lower, and to the great diminution of the total breathing space; while Dr. Chadwick admits that the compression of the lower part of the chest may directly lead to consumption. The greater relative frequency of this disease among men is from their exposure to greater vicissitudes of temperature, and is not connected with the present question.

Your other correspondent, E. H., remarks that there is about three times as much breathing space as is needed in ordinary respiration. But the full amount may be required at any moment of increased exertion, and, if unattainable, may result in serious injury to the individual. I have known a lady remain in a fainting, semi-unconscious state for an hour from this cause after the exertion of dancing.

Dr. Chadwick avers that a woman is better in health while wearing a corset than without one, a statement with which I certainly disagree, at the risk of adding to the differences of doctors. If a woman long used to the support of stays leave off wearing them, she will doubtless feel their loss; but if unused to such artificial support, the wearing them will add to their ills, and probably produce ailments she never experienced before; though, if begun in youth, their development may be very slow and gradual. All analogy would lead to the conclusion that the compression of *any* part of the body, whether the waist, the foot, or any other part, is harmful, even as it is unnatural. It is only disease, including debility, that needs support. The figure is rendered inelegant, rather than elegant, as would be plainly apparent were an undraped statue of a modern corset-wearing lady compared with the Venus of the art galleries. In the mass of coverings enveloping the body in the present day the true natural and artistic form has been lost, and an artificial one, varying with fashion, introduced.

The ancient Greeks, who knew not the corset, had a true knowledge of the beauty of figure, and their lighter and simpler vestments covered, without distorting, the human form.

Fashion's most notable result, if not object, is the crippling of the human body, as the proverb boldly says, "il faut souffrir pour être belle," and seeks to displace natural beauty and grace for a constant desire for change and exaggeration. The remedy is to clothe the figure so as not to destroy or contradict the outlines of the body, but rather to show them clearly; and at the same time to allow freedom of movement and growth.

To help individual action in this matter, the Rational Dress Association has been formed, which deserves the support of every intelligent lady in its endeavours to combat the stupid vagaries of fashion, to show how to dress rationally, and to restore the pristine beauty of the human figure. This will be a gradual work; nor is sudden change desirable, but reason and science, which is applied truth, must eventually succeed. RICHMOND LEIGH, M.R.C.S.

Park-road, Liverpool.

LIFE HISTORY OF A PLANT.

[621]—In the article so entitled in No. 52 of KNOWLEDGE I read that the quantity of water exhaled by the leaves during transpiration "depends on the state of the atmosphere, which when moist almost wholly prevents exhalation; on the other hand, in very dry weather exhalation takes place too rapidly, and the plant withers." In McNab's "Outlines of Physiology," p. 100, I read the result of his experiment on a cherry-laurel, which in sunlight and in a saturated atmosphere lost 25·96 per cent. of water in an hour, and in sunlight and in a dry atmosphere lost only 20·52 per cent. of water in an hour. He goes on to state that a "saturated atmosphere and sunshine can only occur very exceptionally, as in tropical climates and in greenhouses; but still, if when they do occur together the above is the result, are the two statements not contradictory? or should the words "in the absence of sunlight" be added to the first quotation? As this is a matter about which I have long been perplexed—for in most botany books I find the same statement as that made by Dr. Prevost—I shall be very glad if any botanical reader can help me to reconcile the two quotations. Another point on which I would ask for explanation is the following:—In the last sentence of the same article it is implied that no waste goes on in a plant—indeed, this is made a point of distinction between animals and plants; but what, then, is the CO_2 which is evolved in the process of respiration? Is not the respiration of plants similar to that of animals? and of the carbonic dioxide exhaled, does not the carbon result from the decomposition of organic compounds? These questions are asked purely with a view to gain information, if possible, and not in any spirit of criticism. ALISMA.

Answers to Correspondents.

*** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

JOHN SPILLER. Thanks for your note, but we cannot very well find much space now for letters about meteorological shortcomings. They lead, after all, to very little.—H. H. The Greenwich Equatorial has an object-glass by Merz, 12¾ inches in diameter; the focal length is about 18 feet. It is mounted in what is called the English manner. I am not very proud of the little book you name; hope one of these days to publish a much improved version. —M. H. C. You write in the tone of a Hampden or Parallax. You think you have on more than one occasion shown me to be wrong, and you evidently think I think so too. Well, I don't. I thought you were simply jesting in your support of Siemens' theory (after you had admitted that it is unsound). And now with regard to these cloud matters. You had said that a straight band of clouds cannot possibly appear to be curved, which (you admit) I know, in the sense in which you use the words, as well as you can tell me. It should have been clear to you that I used the words in a different sense. I used them, in fact, in their ordinary sense. A band of clouds really straight appears to the eye to pass upwards from the horizon (in the particular case I dealt with) to a point high above the horizon, and then to descend again to the horizon, in such sort that any one looking at it says it seems to form an arch. I speak of this band as appearing curved to the eye. Then I show how this appearance of curvature is brought about,—obtaining a projection which indicates the varying distance of the band from the horizon. On this you obtrude a comment which implies that as the band is really straight, it really looks straight —if only what we see is rightly interpreted. So you might say of any illusion, that it is not really an illusion, because if we rightly reason about it, we shall perceive that it is just what we ought to see.—H. A. DUGDALE. You will have seen ere this that that aspersor of your sex was very fully dealt with.—J. CRAM. It seems to me the views you have (correctly) ascribed to me are sound. Professor Tait's are, as you may judge, only second-hand versions.—W. and S. Nay, but the projectile would reach the ground in the same time in both cases. All that happens when a great horizontal velocity is given to it is that it travels a long way before it reaches the ground, but it travels that distance in a very short time. You have quite correctly interpreted Professor B. Stewart's correct statements.—F. H. HABBEN. To all your objections there is one answer. The evidence is all in favour of the process which you seem to find improbable. We have the clearest possible evidence that plants undergo such changes as Mr. Grant Allen describes. It may seem easier to suppose that all the varieties were separately created. I cannot say I find it so. I find the idea of special creation very difficult to conceive—though that is no reason for rejecting it. But as that is not the way in which we find that the Creator does provide or arrange matters, we must accept what we see. I can imagine an Ephemeron saying that it seemed to him far more natural to suppose each tree and plant had been made just as he saw it; and that he could not believe each twig, and branch, and leaf, and bud had been developed; but facts would be against that short-lived and eke short-sighted reasoner.—C. H. SUTTON. How do you mean "favours?" The publishers have bought up every copy of the earlier numbers they could lay their hands on to make up a few extra volumes, all those originally bound having long since been sold. You appear to think they ought to cut out the earlier numbers any new subscriber may want from the volumes thus bound, spoiling a volume worth half-a-guinea, to sell perhaps for threepence a number which they had bought back at double that price. Surely the injustice of which you speak is nearer you than you seem to know.—A. SMITH (1) wishes to know how to make a storm-glass. (2) Mr. Proctor lectures at Hull on Dec. 12; subject not yet decided.—R. J. H. The rule is very simple. Square the number of miles, and multiply by eight. You then have the geometrical depression in inches, that is the distance at which a straight line tangent to the surface at one end of that distance passes above the other end; but as, owing to atmospheric refraction, the line of sight is not quite straight, the real depression is rather less, and for average state of air is given by taking six inches as the depresssion instead of eight. Your letter about comets' tails marked for insertion. As regards nutation, where is friction to come in? —A. Mc'D. No; the points at which the different planets reach the parts of their several orbits where they are nearest the sun are not in the same direction as seen from the sun. In the pictures of the orbits with which I illustrated my article on astronomy in the *Encyclopædia Britannica* I have shown the position of all the major axes of the orbits.—HENRY M. You are, of course, right. Our answer was written correctly, however. We wrote that Carlyle's statement was quite incorrect; no motion brought about by internal reactions alters the position of the centre of gravity. The word was printed "any." Unfortunately when correcting proof a momentary lapse of attention caused us to make wrong what was right and leave wrong what was already wrong.—P. Q. R. Please notice preceding reply.—W. P. DANGERFIELD. You quite misunderstand my meaning. It is not at all from any straitlaced views about morality that I find reason to object, but because a tacit assumption is made that rank should make a difference in our estimate. But have you read the story of these intrigues, and can you still speak of affection as in question?—W. S. BROOK. There is no such law. The farther the ball is from the bat the less is its velocity.—T. R. ALLINSON. It is very pleasant to have such kindly words from so valued a correspondent.—W. S. I really do not know why each year seems to pass more quickly than the last. It certainly is so—worse luck. I do not see that you can do better than to study "Darwin's Origin of Species" (later editions, of course). Time, time, time.—AN OLD PAULINE. The writer was, I believe, divided between the question of grammar and that of rhyme. What would you have had him do? If he had used the tense of the original you would have ridiculed that unjustifiable future. He knew quite as well as you could tell him, that with the correct tense for a present statement the line would no longer scan correctly. But Grammar before Gradus, Syntax before Prosody. As I am the writer in question, I may claim to know why I changed the tense, despising the quantity. If you would have given the line as it stands in Horace without some antecedent words, to change the tense, then would you have deserved the punishment you suggest for me.—J. WATSON, JUN. We really cannot insert your defence of spiritualism.—H. L. J. Cannot insert a recommendation which, however fairly given, would open the door to any number of gratis advertisements.—J. W. B. Yes, if you do not take the square of the distance; but then you ought to take the square of the distance.—J. P. K. The mistake was the result of an unfortunate chance, the letter getting separated from the enclosure.—A CONSTANT READER. Read "offended" for "offensive" and I agree with you. "Forgotten," no; that is not one of those things which should "be washed in Lethe and forgotten," at least by the wise. I am but one of thousands who noted it as a thing well worth remembering, not for a few years, but for generations. It revealed *so much*. By many it may be remembered as an injunction, not so by those who, like myself, would not cross a street or a room to see a procession of all the Emperors and Kings in the earth's four quarters, unless some of them chanced to be persons who had benefited their kind: (not that I have a particle of feeling against them; they simply do not interest me). You speak of "cowardice in attacking those who from their position cannot reply to such attacks." Pardon me if I remark that you must *know* this is absurd. "Persons who from their position can say what they please," even when addressing the race which stands easily first in power and influence throughout the earth (which I suppose you will admit to be true of English-speaking nations) would be much nearer the mark. Also (a mere detail), there was no attack. I simply repeated a warning which was *meant*, I take it, to be noticed. You are slightly mistaken about the "majority" of readers; say, rather, one in a hundred.—J. A. FRASER. It is a simply organic substance, the Nostoc of German fable. The superstition that it is a fallen star is, as Humboldt somewhere remarks, a very old one. Dryden, speaking of Chapman's "Bussy D'Ambois," says:— "I have sometimes wondered in the reading what has become of those glaring colours which amazed me upon the theatre; but when I had taken up what I had supposed a fallen star I found I had been cozened with a jelly, nothing but a dull cold mass, which glittered no longer than it was shooting."—T. H. M. I have very little doubt that if the comet were to rush straight into the sun, it would very appreciably increase his heat. But if it *is* to be absorbed, the process of absorption will necessarily be gradual.—A. BLAKE. There is no saying what would happen if a whole army of comets were to arise and swoop upon the solar system. If the skies fell, we might or might not have more larks than usual.—M. W. BROWN. So many were against the weather charts that it would be unfair to resume them. We did not give the names of a tithe of those who were opposed to them. As to the other question, I imagine the ordinates are drawn, and then through their extremities a curve is drawn freehand. This would be near enough.—SIGMA. I should say Alpha, certainly. His fittings are much more satisfactory.

Our Mathematical Column.

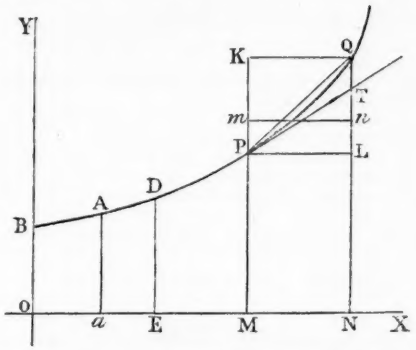
EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

By Richard A. Proctor.

No. XII.

I PROPOSE now to give two geometrical illustrations of a differential coefficient, which, when their nature is rightly understood, and especially the circumstance that the various values of a function can *always* be expressed by means of a curve, will be found of great value in indicating the real meaning at once of differentiation and integration.

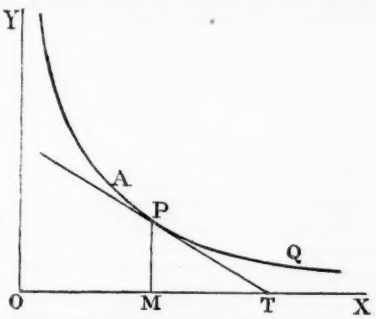
Let O be the origin, O X and O Y, at right angles to each other, the axes of x and y.



Then the x we have been dealing with—our independent variable—is measured along O X, and y the dependent variable along O Y. So that when we write $y=f(x)$, *i.e.*, y is such and such a function of x, we may represent any values of x by O M, O N along O X, calculate the resulting values of y, and set up corresponding lines M P, N Q parallel to O Y. If we suppose this done for all values of x, we get in every case a curve such as is supposed to be shown in part in A P Q, the ordinates as M P, N Q representing the values of y corresponding to the values of x represented by the abscissæ, as O M, O N respectively.

Supposing, then, that when $x=$O M, $y=$M P, we may take M N to represent a finite increment of x or Δx, and get N Q for the corresponding value of y. Draw P L parallel to O X, cutting off N L = P M from Q N, this new value of y,—or $y+\Delta y$. Then P L $=\Delta x$ and Q L $=\Delta y$. And what we have represented by $\frac{\Delta y}{\Delta x}$ is the ratio Q L : P L, or the tangent of the angle Q P L, when P Q is a secant line. If now we imagine N brought nearer and nearer to P M, it is manifest that the secant line P Q draws nearer and nearer in position to the tangent line P T, and the ratio Q L : P L approaches nearer and nearer in value to the ratio T L : P L, the trigonometrical tangent of the angle which the geometrical tangent to the curve A P Q at P makes with the axis of x. Hence the differential coefficient $\frac{dy}{dx}$ = tangent of the angle T P L.

Here we have at once an illustration of the geometrical meaning of a differential coefficient and a useful application of the differential calculus. The reader of treatises on elementary plain coordinate geometry knows how important a process is the determination of the equation to the tangent at a given point of a curve, and how cumbrous is the method which has to be employed for its determination by elementary methods. With the differential calculus the process is simplicity itself.



Thus, suppose A P Q is a part of the rectangular hyperbola whose equation is

$$x\,y=a^2$$

and that we require the equation to the tangent P T at a point P, whose ordinates are O M $=x_1$ and P M $=y_1$. We have

$$y=\frac{a^2}{x};\ \frac{dy}{dx}=-\frac{a^2}{x^2}\text{ whence tangent P T X}=-\frac{a^2}{{x_1}^2}$$

and the equation to P T is, therefore,

$$\frac{y-y_1}{x-x_1}=-\frac{a^2}{{x_1}^2}=-\frac{y_1}{{x_1}^2}$$

or,

$$x_1y+y_1x=2x_1y_1=2a^2$$

Again, the equation to the ellipse with origin at centre and major axis as axis of x, is

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$$

or,

$$y=\frac{b}{a}\sqrt{a^2-x^2};\ \frac{dy}{dx}=-\frac{b}{a}\frac{x}{\sqrt{a^2-x^2}}$$

Wherefore the equation to the tangent at a point x_1, y_1, on the curve is

$$\frac{y-y_1}{x-x_1}=-\frac{b}{a}\frac{x_1}{\sqrt{a^2-{x_1}^2}}=-\frac{b^2x_1}{a^2y_1}$$

or,

$$a^2y_1y+b^2x_1x=a^2{y_1}^2+b^2{x_1}^2=a^2b^2$$

i.e.,

$$\frac{y_1y}{a^2}+\frac{x_1x}{b^2}=1.$$

Our Whist Column.

By "Five of Clubs."

DEAR FIVE,—I have just been looking over your notes on the play of the illustrative game (p. 367, No. 52) which I sent to you two weeks ago. It seems to me that your remarks on Z's play may seem to him rather *uncompromising*. Suppose he should be a reader of Knowledge and recognise the game. Might it not seem to him that, as a visitor, he should have escaped comment?—Faithfully yours, Editor.

Dear Editor,—Impossible to annotate a game fairly without noting errors of play. But are you in earnest? Who was it sent me a question two weeks ago, *relating to play at the very same* meeting of your club, and telling me to "be as severe as I pleased in pointing out error," &c.? Such mistakes are made in moments of carelessness by the best Whist players, and no true lover of the game objects to comments on them, if sound. If unsound, they can always be refuted.—Yours faithfully, Five of Clubs.

Dear Five.—Well, you certainly responded plainly enough to my request for plain speaking, and rapped P. A. R. (R. A. P. inverted) at p. 347, pretty severely. But not every one enjoys as I do a fair and well-delivered thrust. Let us hope our visitor shares your editor's tastes. I agree with you that no player ever passes an evening without laying himself open to some criticism. Still, it would pain me very much if any one's feelings were at all to suffer under your comments. I will see if I can recall the game in which I blundered so egregiously, and you shall criticise that if you like.—Faithfully yours, R. A. Proctor.

The Whist Editor of the *Australasian* has been good enough, at our antipodes, to watch the progress of our Whist Column, in the hope that we had taken up the mantle of the "Westminster Papers;" and now he is disappointed that we have not adorned ourselves with that garment. Considering we very definitely indicated a quite different purpose, this is not very much to be wondered at. We proposed from the beginning, or rather at the beginning, to describe the elementary principles of Whist, such as the leads, play second, third, and fourth in hand, the return of the lead, and such matters, showing how inferences may be formed as the play progresses, and the importance of making and remembering such inferences, leaving to a later stage the principles which guide the general conduct of the hand and may lead the practised player to depart as the game progresses from the mere conventional line of book play. In a word, we proposed (and still propose, for much of this initial matter remains still to be written) to teach the beginner those rules which every Whist player ought to know, and which beginners ought, for the most part, to follow closely. The "Westminster Papers" had a quite different purpose.

In carrying out our plan, we had occasion in the number for June 30 (Vol. II., p. 84), to give a game specially to show how

inferences might be drawn. (In so many words we said that was the purpose for which the game was given.) We had nothing to do with the conduct of the game by the several players, only with the inferences as the successive tricks were played. The Whist Editor of the *Australasian* quietly assumes, however, that we approved of *Y*'s play (who most absurdly—considering the score—signalled for trumps, and continued to play a forward game after clear evidence that he was ruining his own and his partner's chances by so doing). Having made this preposterous assumption he, of course, very easily condemns us for not doing what we never proposed to do. "We readily acknowledge that 'Five of Clubs' writes learned and lucid notes about the details and the incidents of the several tricks," which (leaving the "lucid," and deleting the "learned" was what we set out to do); *but*, "he ignores the broad principles of the game," &c., which also we proposed to do—for the present.

However, in the case of this particular example, he cavils with our inferences, undertaking to show their incompleteness, but only citing one example, where surely he cannot suppose he is telling either us or our readers anything new. It occurs in the first round, which runs

A	*Y*	*B*	*Z*
D. Ace.	D. Three.	D. Six.	D. Seven.

(*A* holding Diamond Five.) On this, instead of saying correctly, "*A* alone knows so far that some one is signalling for trumps," we wrote, rather carelessly, but still the real state of the case is too obvious for any one to be misled, "*A* alone knows thus far that *Y* is signalling." Surely the Whist Editor of the *Australasian*, who credits us with learned and lucid notes, can hardly think either we ourselves, or the veriest beginner among our readers, could fail to see all *A* knows is that a signal has been begun.

Later on, indeed, he shows, justly enough, that in touching on the result (in which splendid hands held by *Y Z* failed to make the odd trick), we did not indicate the best way for *Y* to retrieve matters after all but hopelessly muddling them. We gave very little attention to the matter, having another purpose (as we plainly said) in hand. But he is quite right; the course we proposed gave only a good chance of saving the game,—the odd trick would have been practically assured if *Y* had refused to be forced at trick ten. We thank him for calling our attention to this point. The error would have been rather a serious one if we had been discussing the general conduct of the game. As we were really considering only inferences, from the tricks as actually played, and chiefly from *A B*'s point of view, this after-touch of error was of very slight importance, and hardly worth noticing. When we begin to discuss actual *play*, we shall be open to criticism on such points.

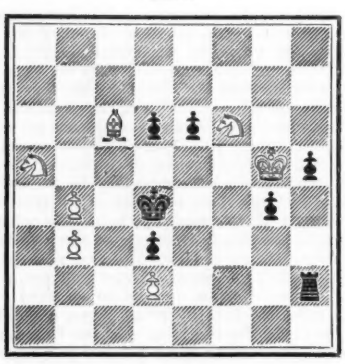
Our Chess Column.

By Mephisto.

PROBLEM No. 59.

By Herbert Jacobs.

Black.



White.

White to play and mate in two moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Experto Crede.—You still maintain that in the position of the Anderssen Kieseritzky game referred to last week, of which a diagram is given on page 302, White ought to win in spite of 20. B to QR3 by 21. Kt to B7 (ch) / K to Q sq 22. Kt takes B / Q takes RP 23. B to B7 (ch) / K to K sq 4. Kt to QKt4. We are sorry that we cannot testify to the soundness of your laborious analytical effort, for if Black now replies with 24. Kt to QB3, he still has a good chance of drawing the game, for supposing 25. Kt takes Q / B to B4 26. B to Q6 / B takes B 27. Kt takes B (ch) / K to Q sq 28. Kt takes P (ch) / K to K2, &c.

J. A. Miles.—Best thanks for problem. It is the one I wanted.

Berrow.—Thanks for problems. Our notice last week referred to a former one.

G. H. T.—Thanks for problems, which will be examined. Hope soon to find you an opponent.

Leonard P. Rees.—F. J. C. problems received with thanks.

Notice to Composers.—In such instances, when we think problems unsuitable for publication, we think it only fair that composers should be informed of the faults in their compositions, both to satisfy their curiosity, and also for their instruction. We propose returning every faulty problem by post, accompanied by a statement of our objections to it. For that purpose composers will oblige by writing their name and address on every problem sent to us.

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